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THE PHYSIOLOGY OF THE CARBOHYDRATES.

The Physiology of the Carbohydrates: their Application as Food, and Relation to Diabetes. By F. W. Pavy, M.D., F.R.S. (London: Churchill, 1894.)

AMONG the most debated subjects of physiology the ultimate fate of carbohydrates within the body stands out as one of the greatest difficulty. A great amount of work has been expended on it, but still many points of vital importance remain undecided. We accordingly hail with pleasure a work containing the results and conclusions of one whose name is indissolubly associated with the subject, as the author of one of the two rival theories around which much of the work of the last thirty years has centred. The book before us contains a revised description of the many researches of the author upon this subject, with a criticism of his earlier results by the light of his later work, and the greatly increased knowledge of the chemistry of the carbohydrates which is now available. Embodying as it does the results of a "life's labour, attended with unceasing laboratory work," we turn to it with more than ordinary interest.

The book is arranged in sections, in the first of which the author gives us a short account of the main chemical characters of the principal carbohydrates, and special stress is laid upon the production of osazones as enabling us to distinguish the different sugars from one another. This is followed by an account of the hydrations produced by ferment action and the changes known to occur through the agency of protoplasm. Succeeding sections deal almost entirely with Dr. Pavy's researches, arranged not in the order in which they appeared, but in such a manner as to gradually unfold the author's argument.

Thus we find described the experiments upon which he concludes that many proteids have the constitution of glucosides. Next the path of absorbed sugar is traced to the liver, and his experiments proving its conversion into glycogen are given. Many experiments upon the amounts of sugar present in arterial and venous blood, in blood from the portal and hepatic veins, and in the liver and other tissues, are given, as well as quantitative results of the amount of glycogen and other carbohydrates present in these positions. The sugar in urine is next discussed, and here he brings evidence to prove that normal urine contains sugar.

Dr. Pavy for his quantitative results relies almost entirely upon the ammoniated cupric solution, and contends that the results obtained by its careful use are thoroughly trustworthy. Where he gives duplicate estimations, however, we note that there are often considerable differences in the two values obtained. Thus, his figures give a further confirmation of the difficulty, if not impossibility, of obtaining very accurate results as to the quantity of sugar present in a solution, by means of a standard copper solution. It is of essential importance to keep this constantly in mind in those cases, such as determination of the quantity of sugar in blood from portal and hepatic veins, or from carotid artery and

jugular vein, in which the results, which we know must be very close to one another, are to be compared. For this reason especially we do not consider that Dr. Pavy has satisfactorily established his position, though it is a most important one for his further conclusions.

His experiments upon the glucoside constitution of proteids are very suggestive and important, but before they could be conclusive it would be necessary to pay much greater attention to the proper purification both of the proteid with which he starts and the "cleavage carbohydrate" which he obtains, and to give quantitative analyses of this latter body. For instance, in the case of egg albumin, which is one of the bodies he uses, we know that it contains a considerable amount of glycogen, and that it is extremely difficult to completely free the proteid from it. But as this latter point does not seem to have been thoroughly attended to in these experiments, we must await further corroboration.

There are many other points about which we expect much discussion may arise, and among these we may mention his conclusions—firstly, that sugar is present in urine; and secondly, that it is present in proportion to the amount present in the blood. In connection with the first of these two points we would refer to the recently published paper of Carl Baisch,¹ who uses the benzoyl chloride method, which is certainly to be regarded as capable of producing more accurate results than the use of the copper test. He, in confirmation of Dr. Pavy, finds that a reducing carbohydrate is present, and he further shows that dextrose is present to the extent of '04 to '09 per 1000 of urine, total-reducing carbohydrates amounting to as much as '06 to '16 per 1000. Dr. Pavy, on the other hand, finds a much larger quantity, which, calculated as glucose, he states, amounts to as much as '5 per 1000.

Now, if we compare the figures given on page 189 as to the amount of sugar present in urine as a consequence of an abnormal small excess in the blood, with the result he gives as present in normal urine, we cannot, from their study, at all agree that these amounts are proportional to that present in the blood. Still less would this conclusion be acceptable were we to take the above-quoted figures of Baisch.

Perhaps the conclusions upon which Dr. Pavy would lay by far the greatest amount of stress is that the major part of the sugar absorbed from the alimentary canal is immediately combined with the peptone simultaneously absorbed to form a proteid, which is then transmitted to the general circulation, and thus to the tissues generally. Dr. Pavy considers that this synthesis is in part effected by the epithelial cells covering the villi. Under one set of conditions, viz. defective oxidation, &c., this proteid may break down and result in the production of fat, or again under another set, e.g. excessive oxygenation of the blood associated with vaso-dilatation, a second form of katabolism is produced, characterised by the production of sugar, which is then eliminated in the urine. Before, however, we can accept these views it will be necessary that much of Dr. Pavy's work should be corroborated. It is of course known, that under the right conditions within the body, fat or sugar can be formed as a result of unusual proteid katabolism; but that proteid is usually syn-

¹ *Zeit. für Physiol. Chemie*, xix. p. 357.

thesised in the simple manner suggested by Dr. Pavy, namely, by the direct combination of a glucose molecule or molecules with a peptone or some similar molecule, requires far more rigid proof than is here attempted.

We should have liked to have seen a greater amount of criticism of some of the many important researches which have been lately published by so many workers; but throughout the whole work, Dr. Pavy bestows but little space in criticising conflicting evidence, much of which remains completely unnoticed.

Though it is thus easy to criticise and point out where errors may have crept in, we can but thoroughly admire the energy and careful thought which are in evidence throughout the work. There is much in it that is suggestive, much that is most valuable. The experimental work which is here set forth so plentifully, forms a field which must be studied and consulted by all future workers in this direction.

PTOLEMY AS A PHILOSOPHER AND ASTROLOGER.

Studien über Claudius Ptolemäus; ein Beitrag zur Geschichte der griechischen Philosophie und Astrologie.
Von Franz Boll, Dr.Phil. (Leipzig: Druck und Verlag von B. G. Teubner, 1894.)

IT is somewhat strange that in the article on Ptolemy in the "Penny Cyclopædia," he is spoken of only as a geographer. His fame is undoubtedly built upon his two great works on astronomy and geography. But the present publication treats of him rather as a philosopher, and discusses also the genuineness or otherwise of the less-known works of the great Alexandrian. A few lines are devoted to his life, of which scarcely anything is known. Dr. Boll sees no reason for calling in question the statement of Theodorus Meliteniota, that he was born at Ptolemais Hermii, in Upper Egypt. He lived to his seventy-eighth year, and died in the reign of Marcus Aurelius, who became emperor in A.D. 161; but it is somewhat doubtful whether the last observation referred to in the "Almagest" was made in 141, or ten years later. At any rate, it is clear that that work preceded the description of the earth's surface (written, Sir E. Bunbury remarks, much more in the spirit of an astronomer than of a geographer), which remained during more than twelve centuries the paramount authority in geographical questions where physical matters were not concerned.

However, as we have said, the present treatise is not occupied with any consideration of these great works. Astronomical and geographical questions do not form its subject-matter, which is rather concerned with the comparatively untrodden ground of Ptolemy as a philosopher, besides a discussion of the genuineness of his writings on astrology in the present acceptance of the term. His work, *Περὶ κριτηρίου καὶ ἡγεμονικοῦ*, has been generally overlooked, the first apparently to refer to it being Heinze, in his edition of Ueberweg's "Grundriss der Geschichte der Philosophie von Thales bis auf die Gegenwart." But besides this professed treatise, Ptolemy touches upon philosophical questions in several places in his other writings.

Dr. Boll's "Studien" is distributed into three principal sections. The first gives, in three chapters, a discussion of his author's views on questions of this nature, as they may be derived from passages in his undoubtedly genuine works. The second is devoted to a critical examination of the genuineness of the *Τετράβιβλος Σύνταξις*, which is astrological, and generally considered as unworthy of the writer. An inquiry into the source of the so-called astrological geography in the second book of that treatise forms the third section of the present "Studien" of Dr. Boll.

Our space in this brief notice enables us only to indicate the general conclusions arrived at under these three heads. A detailed discussion of the views propounded by Ptolemy on psychological and other philosophical questions shows that he must be classed as an eclectic, but with distinctly peripatetic principles. This appears in the "Harmonics" as well as in the work first mentioned. But in his teaching a number of stoical propositions is also to be found, and it is not in these only that Aristotelian ideas are rejected or set aside, for a tendency is manifested to accept some Platonic doctrines on psychology, whilst Pythagorean speculations on numbers form the foundation of the third book of the "Harmonics."

A very careful and elaborate comparison of expressions used in the *Τετράβιβλος*, and in the smaller work *Καρπός* (which is in fact a collection of aphorisms), with Ptolemy's great astronomical and geographical works, proves that the former is genuine, but the latter is not, being evidently the production of some astrologer of later date.

Dr. Boll's conclusion with regard to the *Τετράβιβλος* agrees with that of previous writers; thus the author of the article "Astrology" in the "Penny Cyclopædia" says: "Though its genuineness has been doubted by some merely because it is astrological, there appears no sufficient reason to reject it." We would gladly do so if we could; but the present examination seems to confirm the Ptolemean authorship but too fully. The admiring English translator in the last century (John Whalley, Professor of Physic and Astrology) affirms that "there is nothing in Astrology but what is there comprehended, nothing there comprehended, but the Quintessence and Divinity of Astrology."

The second book of this treatise gives a system of what Dr. Boll calls astrological ethnography, *i.e.* the stellar influence on different parts of the world and their inhabitants according to the signs of the zodiac which are especially supposed to rule over each. The sources of this, by a comparison with earlier writers, are discussed by Dr. Boll (led so to do by a small treatise published at Berlin by Paul Wendland in 1892) in the third section of his work, which shows great industry and research, it being difficult to disentangle the subject from that of the effects of climate on the human race, so that matters of this kind require very careful handling. We may take an instance of this from our own Shakespeare. When Prospero says his zenith doth depend upon a most auspicious star, the allusion to astrology is patent. But when the melancholy Jaques, in *As You Like It*, is made to describe human life as divided into seven stages, it is somewhat straining a point (Dr. Boll refers to Steevens as having anticipated